

FIRST HEXACTINELLIDA (PORIFERA) (GLASS SPONGES) FROM THE GREAT AUSTRALIAN BIGHT

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The four species of Hexactinellida described are the first members of the class reported from southern Australian shelf and slope waters. The large vasiform *Pheronema amphorae* n. sp. is the first known member of the genus outside the Atlantic region bearing a well-developed annulus. *Euplectella regalis*, previously known only from the holotype, is represented by two new individuals. A very large specimen of *Regadrella okinoseana*, exhibiting the extremely rare feature of sieve plate fusion, offers new data which permits synonymisation of all stauractin-bearing regadrellids.

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Knowledge of the hexactinellid sponge fauna is rudimentary in all but a very few marine communities. Few are more inadequately documented than that of the continental shelves and slopes of the south and west coasts of Australia. Only two major oceanographic expeditions have sampled in or near these waters. In 1874 H.M.S. 'Challenger' collected four new species (Schulze 1887), all from oceanic stations well south of the continent (Fig. 1) — Sta. 157: *Holascus polejaevi* Schulze and *Caulophacus pipetta* (Schulze) (as *Balanella*); Sta. 158: *Hyalonema conus* Schulze; Sta. 160: *Holascus fibulata* Schulze. During the British, Australian and New Zealand Antarctic Research Expedition (BANZARE), the R.R.S. 'Discovery' passed over the shelf in 1930 and offshore in 1931. While results of work on the BANZARE Antarctic sponges have been published, those on the Australian and subantarctic sponges, planned for a separate account (Koltun 1976), remain unreported.

This report thus represents the first published record of identified Hexactinellida from the continental shelf and slope waters of southern Australia. The four species were collected at separate stations in the Great Australian Bight (Fig. 1) by F.V. 'Adelaide Pearl' and F.V. 'Saxon Progress' during July and August 1988. The specimens, which were kindly made available for study by Shane Parker, Curator of Lower Marine Invertebrates, South Australian Museum (SAM), are now in the permanent collections of that institution.

SYSTEMATIC DESCRIPTIONS

Class Hexactinellida Schmidt, 1870
Subclass Amphidiscophora Schulze, 1899
Order Amphidiscosida Schrammen, 1924
Family Pheronematidae Gray, 1870

Genus *Pheronema* Leidy, 1868

Diagnosis

Schulze (1904) (emended): body form usually cup- or bowl-like with a distinct gastral cavity, but extremes include plate and spherical shapes; gastral margin usually defined by a complete or incomplete fringe of marginal prosthelia; lateral body surfaces bear long pleural prosthelia singly or in tufts; basal prosthelia project from the inferior body surface in numerous distinct bundles but occasionally as single spicules or in a single bundle; large prosthelia are exclusively monactins, either sceptres or bidentate anchors with strongly or gently recurved flukes; smaller macruncinates are components of all prosthelia bundles; basal rays of pinules are straight and oriented perpendicular or slightly oblique (downward) to the pinular ray.

Pheronema amphorae n.sp.
(Figs 2-4)

Material Examined

Holotype: SAM S696, continental shelf, 183 km south of Cape Adieu, South Australia, 33° 42' S, 132° 25' E, 130 m depth, 12 August 1988, coll. B. Jubb, F.V. 'Saxon Progress', Sta. C4, trawl, in ethanol.

Diagnosis

Pheronematid with deep cup-shaped, nearly tubular body. Large terminal osculum bordered by fringe of sceptres as marginalia and encircled a short distance below by an annulus of long sceptres as pleuralia. Thorned, gothic-arched basalial, 126-264 μm across the anchor, project from the lower half of body in distinct bundles. Uncinates in four distinct size classes ranging from 168 to 1816 μm , in mean length. Microscleres include two size classes of amphidiscs, spiny oxyhexactins and oxypentactins, and siliceous 'pearls'.

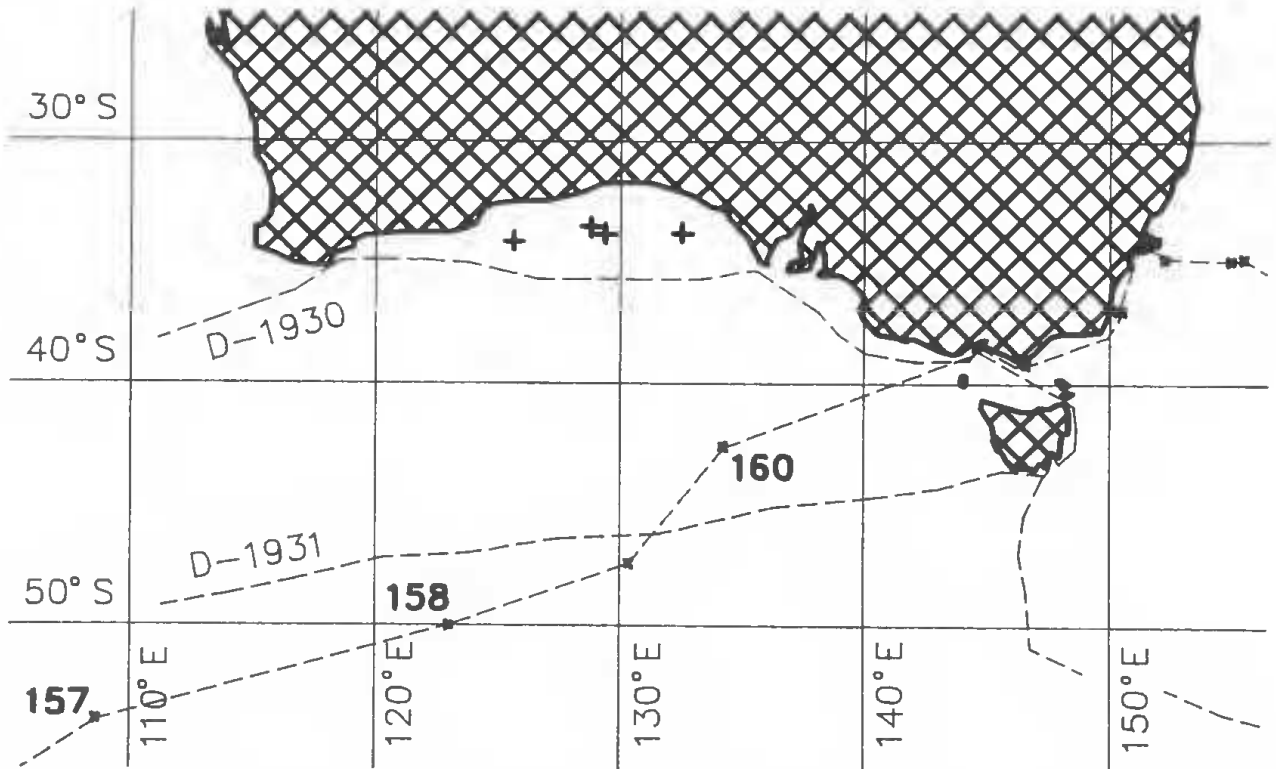


FIGURE 1. Map of southern Australian waters with collection stations reported here (+) and tracks of 'Challenger' (with station numbers), and 'Discovery' (equal longitude/latitude computer projection).

Description

Morphology: The only specimen, moderately damaged during collection with loss of much of the oscular margin (Figs 3 and 4), is reconstructed in Fig. 2a. The body is vasiform or almost tubular, with dimensions: 22 cm length, 13 cm diameter, 7 cm oscular diameter, and 1.8-3.2 cm wall thickness. The texture is soft and fragile, with internal structure visibly cavernous. The oscular marginal fringe, projecting 1.3-2.5 cm, consists mainly of large sceptres in bundles of 5 to 20 spicules. Most are 70-100 μm in diameter and broken distally, so they remain as smooth shafts with acute internal ends. Their monactin nature is established by associated younger developmental stages. Macruncinates comprise approximately 10% of the fringe spicules.

The external surface is generally smooth in overall contour and consists of four recognizable zones (Fig. 2a): a felt zone approximately 2.5 cm wide bordering the marginal fringe, an annular zone of long sceptres *ca* 0.5 cm wide, a 'smooth' zone extending over the remainder of the upper one-half of the body, and a basal zone extending over the lower body half.

The felt zone is covered by a dense nap of vertically oriented spicule bundles, extending 0.2 cm above the body surface. The bundles consist of short, thin sceptres (85%, 10-25 μm diameter) and macruncinates (15%). Few dermal pinules cover the surface between bundles. The annular zone, like the marginal fringe, consists of very large, often broken sceptres, up to 160

μm diameter, projecting up to 5 cm, with spicules of the felt level continuing as a lower stratum. A few very long, thin 'silk' spicules, 7 μm diameter by 10+ cm in length with broken distal tips, project with the longer sceptres. The smooth zone is bounded by a porous surface covered by dermal pinules with a sparse population of the small sceptres and macruncinates of the felt zone persisting. Long thin basalia occur occasionally in this zone, projecting 5-15 cm singly or in small groups of up to five. The basal zone includes components of the smooth zone with addition of basal anchor bundles spaced 0.5-1 cm apart. The bundles are 0.2-0.4 cm in diameter and consist of 10 to 50 basal anchors of all sizes, with single spicules reaching over 300 μm diameter. The basal terminus of the body is bare of root bundles. A few sceptres up to 3 cm long also occur in the root bundles. Bundles, up to 32 cm in length, intertwine to form a massive anchor mass. In natural position these probably radiate evenly through a hemisphere of bottom sediment.

The gastral surface is smooth and even, covered only by a layer of gastral pinules. There are no openings of large exhalant canals nor indication of a special gastral sieve.

Megascleres (Table 1): No proper diactine megascleres (uncinates excluded) occur in this species, as characteristic of the genus. Large pentactins (not figured) serve as parenchymal principalia as well as hypodermalia and hypogastralia. They are smooth-

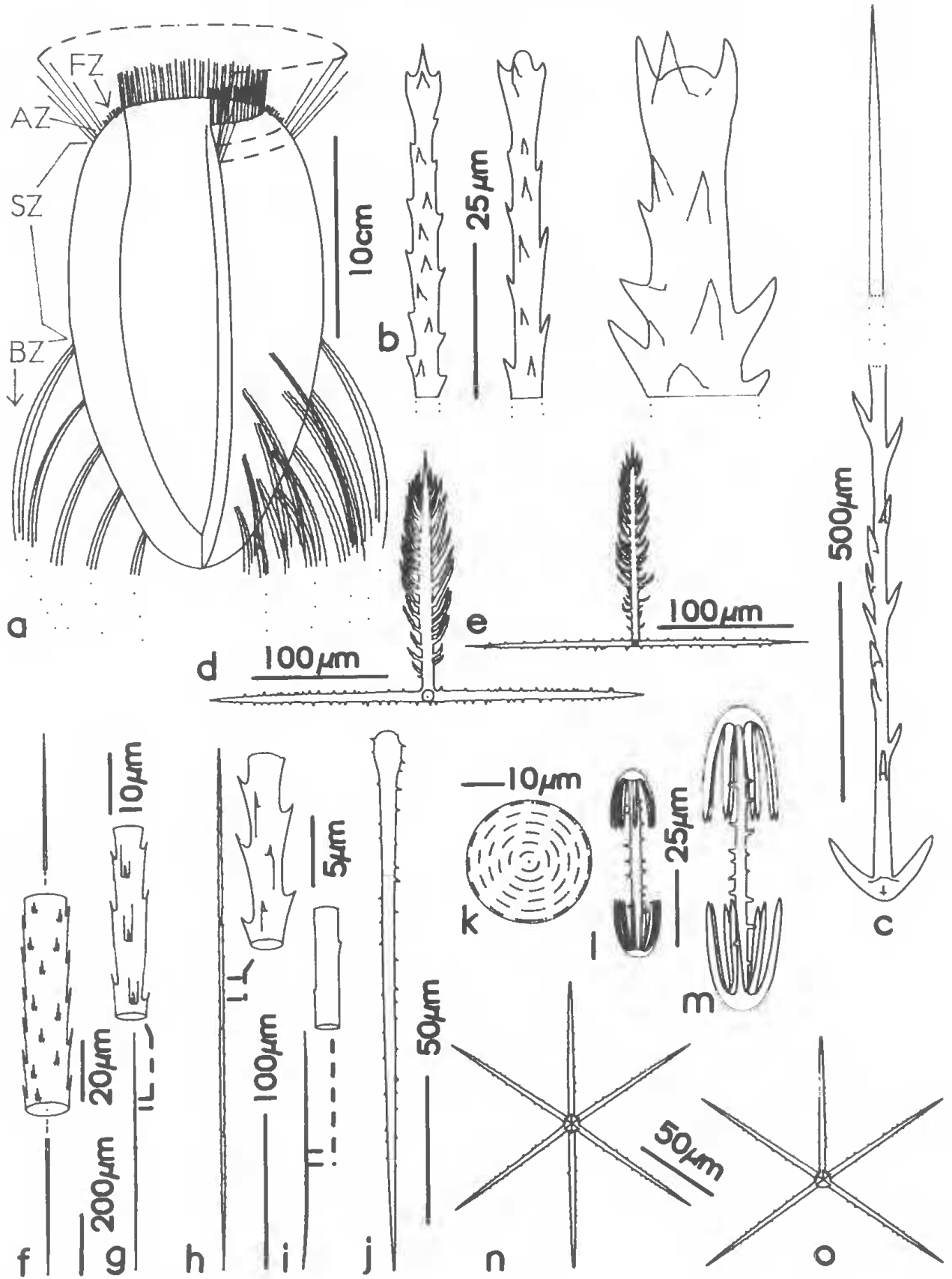
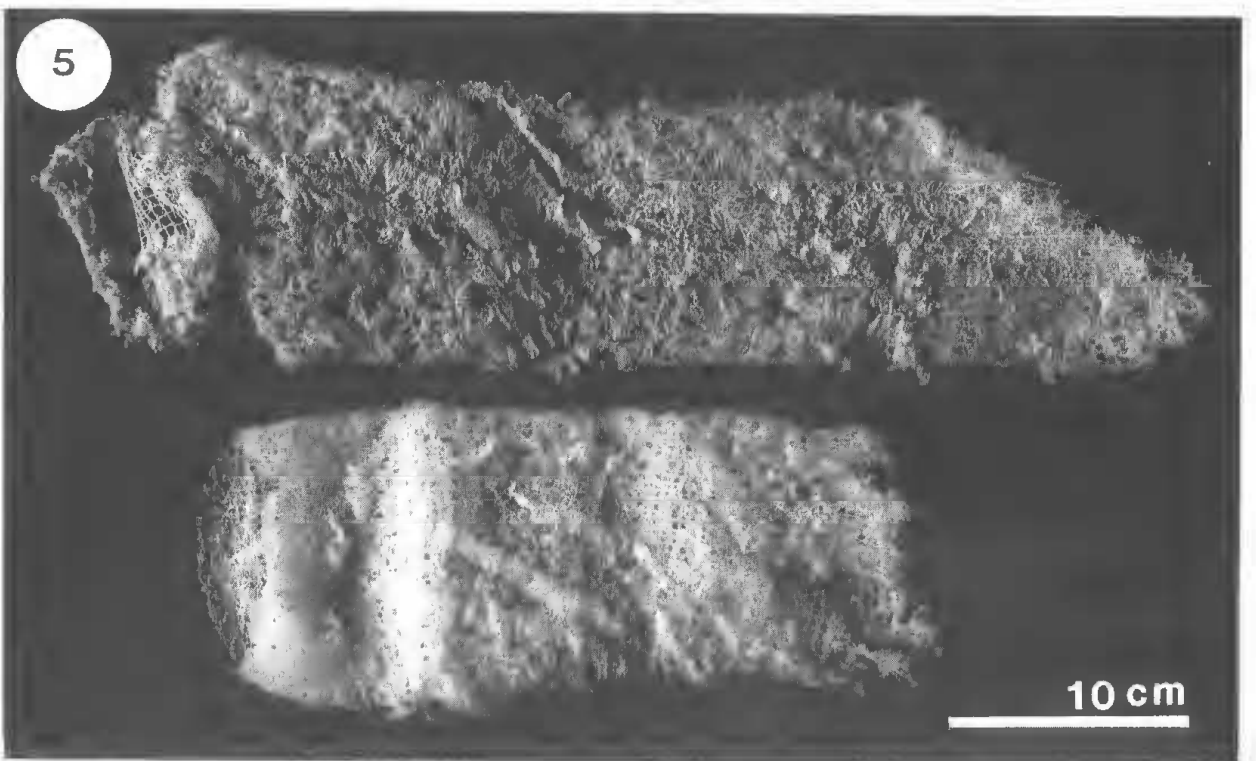
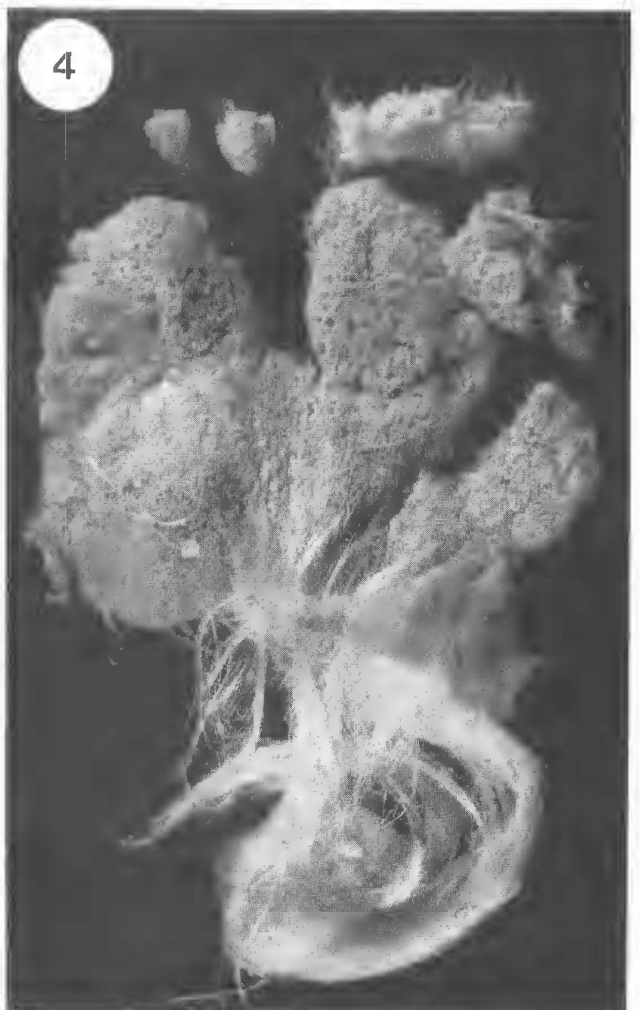
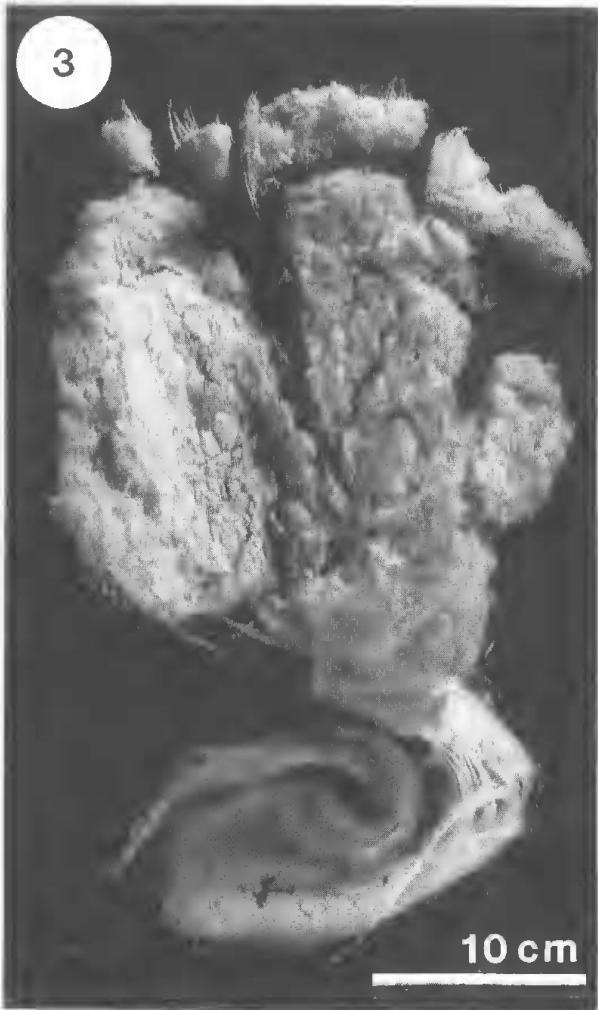


FIGURE 2. *Pheronema amphorae* n. sp. holotype SAM S696. a, reconstruction of body form with external zonation (see text for explanation); b, sceptre tips; c, basal anchor; d, dermal pinule; e, gastral pinule; f-i, uncinate 1-4; j, monactine club; k, siliceous 'pearl'; l, micramphidisc; m, mesamphidisc; n, spiny mesohexactin; o, spiny mesopentactin.



surfaced and either regular when associated with body surfaces or irregular when parenchymal. Monactine sceptres, or 'cuspidates', (Fig. 2b) occur as a major component of dermal spiculation, including the marginal fringe and annulus. Younger (shorter) sceptres have distal spines directed outwards toward the spicular centrum with only the proximal quarter of the shaft smooth. As spicules increase in size the relative proportions of shaft texture are gradually reversed until, in the largest intact examples, spination is restricted to a small distal section. Uncinates were divided into size classes by preliminary size-frequency analysis of 600 random length measurements. The two larger sizes (Figs 2f and g) have straight shafts and distinct barbs. The smaller classes (Figs 2h and i) both lack barbs at the light microscope level; the larger of the two is straight-shafted and bears sharp spines while the smallest is distinctly curved and carries only bracket facets. Basalia (Fig. 2c) have typical bidentate anchors and coarsely thorned distal shafts. The anchor is of the gothic arch form. No smooth-shaft basalia are present, thorns being especially pronounced at the earliest formative stages. Thin filiform spicules or 'silks', ca 7µm in diameter, are present in low abundance in the annulus. They bear sharp proximal tips but are universally broken distally. Slight swellings at regular intervals along the shaft of some examples are interpreted as incipient thorns. These are probably

monactins, as are all other prostalia, but of uncertain taxonomic significance.

Mesocleres (Table 1): Recognition of this major category of spicule is forced by similarity of form and size between pinules, usually categorized as megascleres, and parenchymal hexactins, usually categorized as microscleres (e.g. microhexactins). Spicule dimensions alone are inadequate to define major spicule categories within Hexactinellida as evident in the range of uncinata size classes above. Dermal and gastral pinules (Figs 2d and e) have typical fir-tree pinulus and perfectly perpendicular and completely spined tangential rays. A few exhibit curvature and reduced spination of the pinular ray, but these variations are rare. Mesoxyhexactins and mesoxypentactins occur as typical parenchymal intermedial spicules (Figs 2n and o). They are completely covered in short spines, and thus intergrade with pinule variants exhibiting reduction of pinulus spination. The distinction between these classes remains nonetheless obvious. Spined monactine clubs (Fig. 2j), or acanthotylostyles in demosponge terminology, occur sparsely as parenchymal intermedials. While uncommon, they are sufficiently abundant and consistent in form to warrant recognition as a distinct spicule type in this species. They may be of rare occurrence in the wider group, Hexactinellida.

Microscleres (Table 1): Amphidisc classes were

TABLE 1. Spicule dimensions of *Pheronema amphorae* n. sp. in µm unless otherwise noted.

Spicule type	Length ± SD	(range)	N	Width ± SD	(range)	N
Macropentactin						
tangential ray	3685 ± 2000	(547-8533)	50	46.7 ± 13.7	(21.6-75.1)	50
unpaired ray	2747 ± 1493	(543-6537)	50	—	—	—
Sceptre	to 6+ cm	—	—	to 160 µm	—	—
Uncinate 1	1816 ± 337	(1217-2749)	50	13.6 ± 2.3	(8.5-19.0)	50
Uncinate 2	796 ± 174	(533-1293)	50	5.8 ± 1.4	(3.5-11.0)	50
Uncinate 3	342 ± 95	(178-621)	50	2.4 ± 0.6	(1.3-4.5)	50
Uncinate 4	168 ± 52	(73-281)	50	1.5 ± 0.3	(1.0-2.5)	50
Basal anchor	to 32+ cm	—	—	216 ± 27*	(126-264)	50
Silk	to 10+ cm	—	—	—	(7.0-8.3)	—
Dermal pinule, pinulus	144 ± 32	(83-242)	50	8.5 ± 1.4	(5.7-11.6)	50
tangential ray	130 ± 20	(87-186)	61	7.1 ± 1.1	(5.0-9.7)	50
Gastral pinule, pinulus	124 ± 30	(61-251)	67	6.9 ± 1.1	(4.2-10.8)	50
tangential ray	129 ± 18	(72-172)	61	6.3 ± 1.1	(3.7-10.5)	50
Mesoxyhexactin ray	95 ± 19	(64-154)	66	3.3 ± 0.5	(2.7-4.4)	25
Mesoxypentactin ray	99 ± 20	(58-166)	66	3.5 ± 0.8	(2.1-4.7)	25
Monactine club	169 ± 32	(119-314)	45	—	—	—
Mesamphidisc	102 ± 11	(88-138)	50	24.8 ± 3.9	(19.2-37.7)	50
Micramphidisc	60 ± 7	(45-77)	50	15.7 ± 2.7	(11.3-23.1)	50
Pearl (diameter)	31.2 ± 12.4	(15.8-82)	50	—	—	—

* widest distance between anchor teeth tips.

FIGURES 3-5. *Pheronema amphora* n. sp. and *Euplectella regalis*. **3 and 4**, internal (left) and external (right) views of *Pheronema amphorae* holotype, SAM S696; **5**, *Euplectella regalis*, SAM S693 (upper) and S694 (gross external transverse ridges are artefacts of the packaging process for specimen transport).

identified by length-frequency analysis of 754 randomly selected spicules; a clear bimodal distribution was obtained. Mesamphidiscs (Fig. 2m) have elongate 8-toothed umbels and a mean width/length ratio of 0.260. Micramphidiscs (Fig. 2l) have proportionately shorter and narrower umbels bearing 9-10.5-13 teeth and a mean width/length ratio of 0.243. Both amphidiscs are distributed throughout the parenchyme and dermal tissues, but are not common in near-gastral tissues. Extensive search for intrinsic macramphidiscs yielded negative results. Spherical 'pearls' (Fig. 2k) of obvious intrinsic production were sufficiently common to accept these as a recognizable skeletal element in this specimen.

Etymology

The name refers to the body form, which resembles the basal portion of an amphora.

Remarks

Schulze's (1904: 151) definition of *Pteronema* excludes the species assigned to *Poliopogon* at that time and is here considered valid. Ijima's (1927: 9) suggestion to move *Poliopogon gigas* Schulze to *Pteronema* is rejected because supporting arguments were not presented. Tabachnick (1988) supported Ijima's suggestion, without assignment of *P. gigas*, and attempted to redefine *Poliopogon*. His redefinition must be ignored since it neglects consideration of principalia, pleuralia, marginalia, and uncinates altogether and, as proposed, would exclude the type species *Poliopogon amadou* Thomson. More recently (Tabachnick 1990) he reassigned *P. gigas* as the type of a new genus, *Schulzeviella*, which differs from *Poliopogon* by body form and presence of microxydiacts. In view of the great variability of body form and microsclere complement accepted for *Pteronema*, these characters seem inadequate for distinction of genera. A revision of the relationship between the three genera must include a thorough and informed review of all species involved.

The genus *Pteronema*, understood to exclude *Poliopogon gigas*, contains 19 species and one subspecies which presently hold nomenclatural validity, although the genus has not been revised and some are probably synonyms. Most are easily compared to *P. amphorae* but a few are inadequately known due to the poor state of the material available to the describer, or to the lack of diligence by the original author. The single character, body form, distinguishes *P. amphorae* from all other species, but alone is insufficient for taxonomic action. The abbreviated inventory of additional character differences presented here is adequate to demonstrate the distinction of the new species. Principalia include hexactins in *P. conicum* Lévi & Lévi (1982), *P. pepo* Ijima & Okada (1938), and *P. placodium* Ijima & Okada (1938), but are exclusively pentactins in *P. amphorae*. The basal

anchor is crescentic in *P. conicum*, *P. echinatum* Ijima (1927), *P. giganteum* Schulze (of Schulze 1886, not Ijima 1927), *P. hemisphaericum* (Gray 1873), *P. ijimae* Okada (1932) (of Lévi & Lévi 1989, not Okada 1932) but gothic-arched in *P. amphorae*. Anchor form was not given in descriptions of *P. barbulosclera* Lévi (1964), *P. pilosum* Lévi (1964), *P. semiglobosum* Lévi & Lévi (1982), and *P. surugensis* Okada (1932). Forms lacking marginalia are *P. annae* Leidy (1868), *P. gigantea* (of Ijima 1927, not Schulze 1886), and *P. ijimae*. Spiny mesoxyhexactins are abundant in *P. amphorae* but are absent in *P. carpenteri* (Thomson 1869), *P. globosum globosum* Schulze (1886), *P. grayi* Kent (1870) and *P. megaglobosum* Tabachnick (1988). A sieve plate, lacking in *P. amphorae*, is present in *P. globosum kagostimensis* Okada (1932), *P. raphanus* Schulze (1894), *P. semiglobosum*, and *P. nasckaniensis* Tabachnick (1990). Micramphidiscs are much smaller than those of *P. amphorae* (entirely outside the range) in *P. barbulosclera*, *P. giganteum*, *P. globosum globosum*, *P. raphanus*, *P. surugensis* and *P. weberi* Ijima (1927). All of these species differ from *P. amphorae* in several other characters. *Pteronema pilosum* remains the most difficult member to compare with the new species due to brevity of its original description (Lévi 1964). Differences in body form, dimensions and spination of dermal pinules, and amphidisc sizes indicate the two forms are quite distinct, but form and size of basal anchors and presence or absence of mesoxyhexactins remain unknown for *P. pilosum*. The new species is most closely related in body form and overall spiculation to *P. carpenteri* and *P. grayi* of the North Atlantic.

The nominal taxa, *P. parfaiti* Filhol (1885) and *P. saccus* Schmidt (1870), must be considered unrecognizable, as concluded by Schulze (1904), until the original specimens are found and their characters assessed. Schulze's (1893) argument that *P. pourtalesii* Schmidt (1870) must be referred to *Rossella* is accepted here. *Pteronema circumpalatum* Schulze (1894), as affirmed by Schulze (1902), is a junior synonym of *P. raphanus*. *Pteronema velatum* is a nomen nudum. It was used without description or indication by Carpenter & Jeffreys (1870) as a provisional name for a Gibraltar specimen later figured as *Rossella velata* by Thomson (1873), now the only recognized species of *Mellonympa*.

Distribution

Great Australian Bight, 130 m depth.

Subclass Hexasterophora Schulze, 1899
Order Hexactinosida Schrammen, 1910-12
Suborder Clavularia Schulze, 1886
Family Farreidae Schulze, 1886

Genus *Farrea* Bowerbank, 1862

Diagnosis

See Ijima (1927: 130).

Farrea occa occa Bowerbank, 1862, Carter, 1885

Abbreviated synonymy:

unnamed – Owen, 1857: 121 pl. XXI figs 9, 9a.

Farrea occa Bowerbank 1862: 1118; 1864: 204, pl. XX, fig. 311 (not pl. XV, fig. 277); 1869: 339 pl. XXIV, fig. 7 (not figs 1-6); Carter 1885: 388 pl. XII, pl. XIII, figs 1-11; Schulze 1887: 277 pl. LXXI-LXXII, LXXVI.

Farrea occa occa Ijima 1927: 131; Burton 1959: 153; Reiswig 1990: 735.

Material examined

One specimen (fragments): SAM S813, continental slope, 232 km east of Cape Arid, Western Australia, 34°03' S, 125°31' E, 1 011-1 020 m depth, 31 July 1988, coll. K. L. Gowlett-Holmes, K. J. Olsson and M. Cameron, F. V. 'Adelaide Pearl', Sta. 15, trawl, in ethanol.

Description

The specimen consists of three main fragments, two of which retain soft tissues, plus numerous small fragments, all presumably from a single original specimen. The largest fragment, 2.8 cm in height by 1.8 cm width, is composed of thin-walled tubules 0.7 to 1.0 cm in diameter, similar to the Japanese specimen of Carter's (1885) redescription. The frame is primarily single layered and square meshed, with conspicuous asymmetry in length of spurs on the two faces. Spiculation includes dermal and gastral spined pentactins, oxyhexasters (99-119 µm diameter) which are often hemihexastrous and merge with oxyhexactins, and pileate clavules projecting in radial bundles in the dermal layer. Terminal rays of the oxyhexasters are longer than primary rays in the ratio 1.3. No tylohexasters or other forms of clavulae are present.

Remarks

On the basis of body form and spiculation, the specimen is assigned to the typical subspecies *Farrea occa occa* in spite of slight differences in proportions of the oxyhexasters and absence of anchorate clavules.

Distribution

Cosmopolitan

Order Lyssacinosa Ijima, 1927

Family Euplectellidae Gray, 1867

Subfamily Euplectellinae Ijima, 1903

Genus *Euplectella* Owen, 1841

Diagnosis

See Ijima (1927: 327).

Euplectella regalis Schulze, 1900

(Figs 5-8)

Euplectella regalis Schulze 1900: 24, pl. VI, figs 1-9; 1902: 61, pl. XXII, figs 1-9, 1904: 132 (key); Ijima 1901: 58 (key); 1927: 327, 334; Burton 1959: 154; Reiswig 1990: 738.

Material examined

Two specimens: SAM S693, SAM S694, continental slope, 194 km south of Eucla, South Australia, 33°26.8' S, 128°41' E, 956-973 m depth, 28 July 1988, coll. K. L. Gowlett-Holmes, K. J. Olsson and M. Cameron, F.V. 'Adelaide Pearl', trawl, in ethanol.

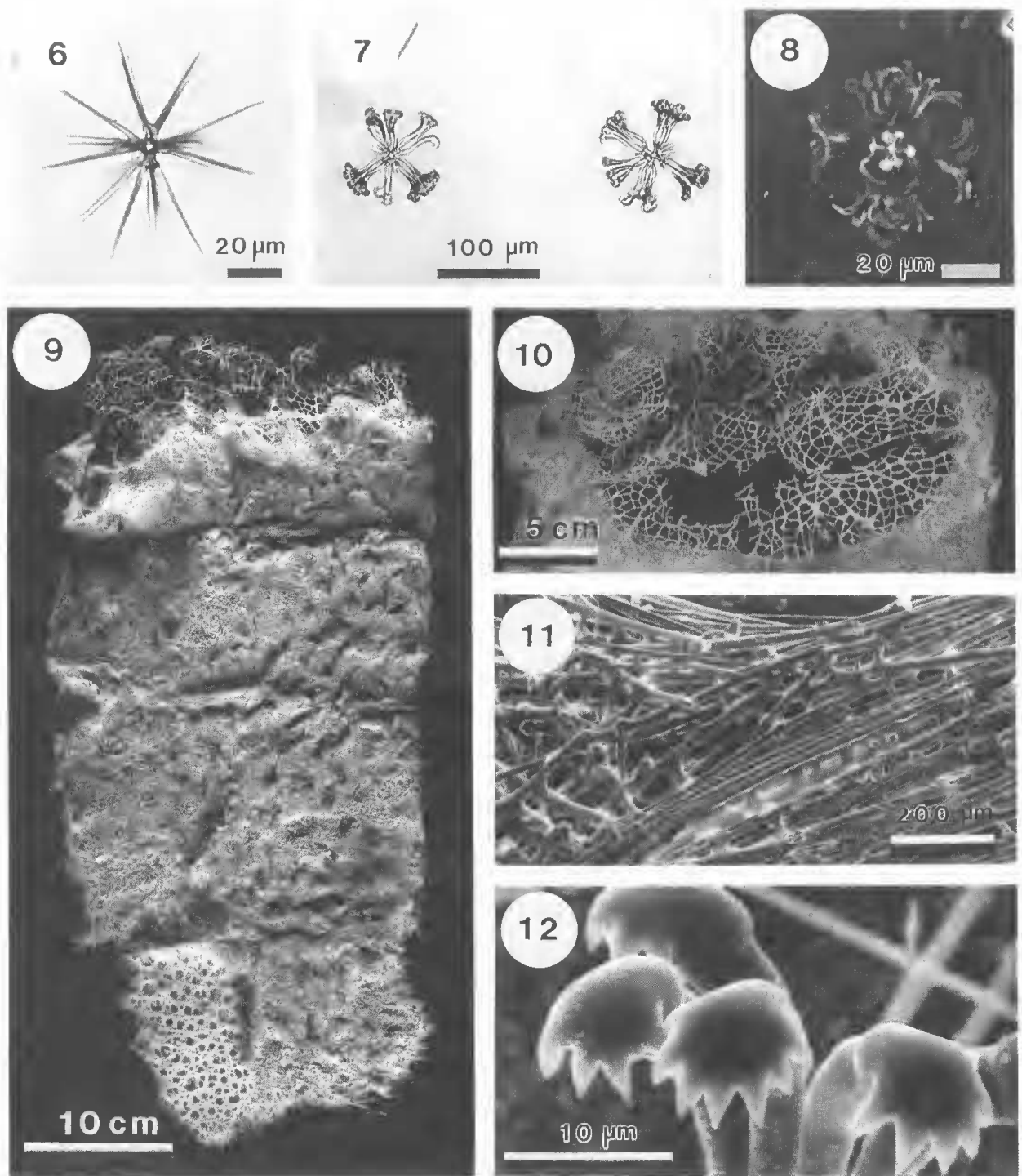
Diagnosis

Euplectellidae with straight, cylindrical body; with nearly flat sieve plate bordered by a narrow marginal collar; local patches of parietal oscula in oblique or longitudinal and transverse rows; soft parietal ridges run obliquely; parietal principalia are stauractins with diactins and triactins as comitalia; oscularia are mainly stout pentactins; microscleres include oxyhexasters with short primary rays, floricones with 3-to-10-toothed, palmate tips, sigmatocomes, and graphiocomes.

Description

Morphology: The two flattened specimens (Fig. 5) are the soft, flexible upper portions of cylindrical individuals of unknown total length. Their respective dimensions (693, 694) are: length 41, 29.5 cm; diameter 8.0, 8.3 cm. Both have narrow marginal collars, 0.65-0.8 cm and 0.63-0.75 cm in width and well developed but soft and thin, oblique parietal ridges to 1.3 cm and 1.15 cm height respectively. Wall thickness varies from 0.30-0.45 cm in both specimens. Parietal oscula are irregularly distributed – in some areas in oblique series and in others in longitudinal and transverse rows. The sieve plates are nearly flat and typical in form. Synapticular fusion is evident only in the lower portions of both specimens.

Spiculation: Parietal principalia are tetractins (stauractins), with associated diactins, triactins, and few hexactins as comitalia. The sieve plate contains stout bent macrodiactins and a few macrotriactins and macrotetractins as principalia, long diactins and triactins as commitalia and short, stout pentactins and hexactins as superficial spicules. Sword hexactins and diactins form the major support elements in the general dermis, marginal collar, and parietal ridges. Parietal oscularia consist mainly of small stout pentactins (62%), but hexactins (26%), tetractins (6.5%), triactins (2.2%) and compass diactins (3.3%) occur (N=346). Four classes of microscleres are common – dimensions are based upon 25 spicules of each (693, 694; min-mean-max). Oxyhexasters (Fig. 6) have very short principal rays, 0.125 of radius, and 2-3-4



FIGURES 6-12. Microscleres of *Euplectella regalis* SAM S693 and *Regadrella okinoseana* SAM S695. 6-8, oxyhexaster, two floricomes (incomplete), and sigmatocome (phase contrast) of *Euplectella regalis*; 9-12, *Regadrella okinoseana*: 9, external view; 10, broken sieve plate; 11, SEM of sieve plate beam showing synapcticular fusion; 12, SEM of floricome terminal ray tips.

terminals: 82-95-110, 86-111-128 μm diameter. Floricomes (Fig. 7) have 3-7-10 terminals: 90-108-124, 89-120-133 μm diameter. Sigmatocones (Fig. 8) have 10-12-14 terminals: 49-56-76, 48-60-67 μm diameter. Graphiocomes are broken in all preparations: centra 21-26-30, 15-21-24 μm diameter; raphide terminals 110-129-147, 69-113-154 μm length. Anchors are unavailable.

Remarks

These specimens are excluded from the fourteen other valid species of *Euplectella* by nature of parietal and sieve plate principalia, parietal ridges, marginal collar, oscularia and presence of oxyhexasters. They agree with all major characters of Schulze's (1900) *Euplectella regalis* but differ in two details, the presence of graphiocomes (as predicted by Ijima 1901: 53), and the distribution pattern of parietal oscula (described as generally in longitudinal and transverse rows in the type specimen, Schulze 1900: 24). Only a small portion of the type of *E. regalis* is figured by Schulze (1900), so verification of his description of oscula distribution would require re-examination of the original specimen. Unfortunately that specimen may be too severely subdivided to resolve the pattern of oscula (2 jars with 3 pieces in the Natural History Museum, London; 3 jars in the Zoologisches Museum der Humboldt Universität, Berlin; main specimen probably in the Indian Museum, Calcutta). In spite of this slight difference, the two specimens are here accepted as the second and third known examples of the species. Both Australian sponges were probably larger than the type specimen which was complete with root tuft and measured 40 cm in length and 7-8 cm in diameter. The tendency for local areas of body wall to develop distribution of parietal oscula in longitudinal and transverse rows is accepted here as a variable character, along with slight differences that are expected to occur in proportions and dimensions of spicules. An emended diagnosis reflects these variations.

Distribution

Andaman Is., 741 m; Great Australian Bight, 956-973 m.

Subfamily CORBITELLINAE Ijima, 1902b

Genus *Regadrella* Schmidt, 1880

Diagnosis

See Ijima (1927: 335).

Regadrella okinoseana Ijima, 1896
(Figs 9-12)

Regadrella okinoseana Ijima 1896: 250; 1901: 223, pls VII, VIII; 1902a: 122; 1902b: 8; 1902c: 691; 1903: 18; 1927: 335; Schulze 1899: 115; 1900: 30; 1902: 67; 1904:

133; Topsent 1904: 375; 1928: 297; Wilson 1904: 35; Schrammen 1912: 182; Kirkpatrick 1913: 64; Reid 1964: cxxvii; Lévi & Lévi 1982: 292, pl. VI; Salomon 1990: 344; Reiswig 1990: 738.

Regadrella decora Schulze 1900: 30, pl. VI, figs 10-18; 1902: 67, pl. XXII, figs 10-18; 1904: 133; Ijima 1901: 223; 1927: 335; Burton 1959: 154; Lévi & Lévi 1982: 293; Reiswig 1990: 738.

Regadrella cylindrica Ijima 1927: 335, pl. VIII, figs 9-21; Reid 1964: xcii; Lévi & Lévi 1982: 293; Salomon 1990: 344; Reiswig 1990: 738.

Material examined

One specimen: SAM S695, continental slope, 232 km south of Eucla, South Australia, 33°45'S, 129°17'E, 999-1110 m depth, 1 August 1988, coll. K. L. Gowlett-Holmes, K. J. Olsson and M. Cameron, F. V. 'Adelaide Pearl', trawl, in ethanol.

Diagnosis

Regadrellid with barrel-shaped body, slightly inflated sieve plate, wide marginal collar (cuff) and rigid, fused basal cup attached to solid substrate; lateral body wall bearing a connected network of smooth-edged ridges which circumscribe depressions containing small parietal oscula; principalia are large gently bent diactins; microscleres include distinctive oxytauractins, floricomes, and graphiocomes.

Description

Morphology: The specimen (Fig. 9) consists of the upper portion of a large individual of unknown total length. It is 48 cm in length and, although now flattened, was presumably oval in cross section, with major and minor diameters measured at the upper end of 22.9 by 14.5 cm. The marginal collar is well developed, up to 2.5 cm wide, and the ridges between the parietal depressions are *ca* one cm in height. Synapticular fusion of lateral wall spicules is absent from the upper 33 cm, and gradually increases from that point towards the torn basal end. The sieve plate, originally nearly flat in shape, is extensively broken due to synapticular fusion of the central half (Figs 10 and 11). Synapticular deposition gradually decreases marginally. The area bounding the junction with the body wall remains free of all but trivial traces of secondary silicification and is flexible.

Megascleres and mesoscleres (dimensions as *mean-max*, $n=25$): The principalia are large curved diactins to 6.2 cm long by 214 μm width. They are accompanied by diactin comitalia and intermedial oxyhexactins. Three classes of dermalia are present. Large sword hexactins in the parietal ridges and marginal collar have tangential rays 130-185-244 μm , distal rays 171-512-788 μm , and proximal rays 301-852-1765 μm in length. Smaller dermals have tangential rays 131-261-391 μm , distal rays 64-125-233 μm but proximal rays either short 47-144-346 μm , or

long 352-492-683 μm . Gastralria are the usual pentactins (not measured). Mesoscleres consist of thick-rayed hexactins and pentactins covering sieve plate beams and spiny intermedial oxyhexactins with rays 104-158-192 μm in length, the latter uncommon.

Microscleres: Oxystaurasters with three (rarely five) terminals are the most abundant microsclere, 73-94-117 μm in diameter. Variants occur as pentasters (6%), triasters (<1%), hexasters (<1%), and octasters (<1%). Floricomes bearing eight terminals per primary are common in dermal structures, 115-131-147 μm in diameter. Terminal expansions carry 3-6-7-8 recurved claws (Fig. 12). The presence of graphiocomes verified by their characteristic centra, 30-35-43 μm in diameter, and abundant raphide terminals, 167-196-242 μm in length.

Remarks

The specimen generally agrees with the descriptions of *Regadrella okinoseana* from Sagami Bay, Japan, by Ijima (1896, 1901) and from New Caledonia by Lévi & Lévi (1982), but differs in a few features. The principalia of the present specimen attain much larger dimensions than those of either of the other two known localities, but this is explained by the larger size and presumably greater age of the South Australian specimen – the largest from Sagami Bay was 42 cm and from New Caledonia 29 cm in total length for intact individuals. The floricomes of the present specimen are larger (mean 131 vs 98-107 μm at Sagami Bay and 90 μm at New Caledonia) and carry more terminal spines (usually 6-7 vs 2-3 at Sagami Bay and undescribed at New Caledonia). The spiny mesohexasters are larger than the Japan specimens (104-192 vs 55-150 μm ray length), but of the same mean size as those from New Caledonia. These differences are accepted as within the range of geographic variation of a species and are not considered adequate for recognition of even varietal status.

Only three species of *Regadrella* contain oxystaurasters as characteristic microscleres, *R. okinoseana*, *R. decora* Schulze, 1900, from near Cape Comorin, Indian Ocean, and *R. cylindrica* Ijima, 1927, from north of Celebes. Review of Schulze's description of *R. decora* suggests that his recognition of this as distinct from *R. okinoseana* was based upon Ijima's poor original description and Schulze's misinterpretation of same. The only differences between these appear to be the lack of oxyhexasters and more angular nature of principalia in *R. decora*, both of which appear to be of dubious value since the oxyhexasters are rare and the principalia are clearly curved in *R. okinoseana*. The distinction between *R. okinoseana* and *R. cylindrica* is equally tenuous, based again on the absence of oxyhexasters, the lack of spiny microxyhexasters, and the greater size of oxystaurasters in the latter. The first two differences are trivial since 'absence' of these uncommon spicule classes depends

upon search effort, and the third distinction is slight, based on nonquantitative data, and is not deserving of even varietal importance, particularly with the greater overlap provided by the South Australian specimen. Both original authors were insecure in their assessment of the validity of the two later species, and recent authors (Lévi & Lévi 1982; Salomon 1990) have supported amalgamation of the stauractine-bearing *Regadrella* species. Synonymy of *R. decora* and *R. cylindrica* with *R. okinoseana* is supported by the data from the new specimen, and is here formally proposed.

Sieve plate fusion, present in this specimen, is extremely rare in lyssacine hexactinellids, and is apparently restricted to individuals of extreme age. It has never been documented by illustration. Chimm (1878: 10) alluded to fusion of the sieve plate in *Euplectella aspergillum* Owen, without convincing microscopic evidence. Ijima (1902b: 4), an authority with extensive observational experience, provided a more convincing statement for *Corbitella speciosa* (Quoy & Gaimard). Tabachnick (1990: 169) reported synapticular fusion in the sieve plate of the 230 mm long holotype of *Regadrella peru* Tabachnick, but provided no photographic record. No other observation of sieve plate fusion is known in recent lyssacinians. The rarity of extensive sieve plate fusion is appreciated since it presents a barrier to alteration of the central meshes. Potential for growth is retained by the lack of fusion at the marginal junction with the body wall. Synapticular fusion does enhance fossilization in these members of the lyssacine hexactinosans (Salomon 1990), a group otherwise poorly represented in the fossil record.

Distribution

Sagami Bay, Japan, 358-832 m depth; New Caledonia 390-505 m depth; SW of Cape Comorin, Indian Ocean, 787 m depth; N of Celebes, 1 165-1 264 m depth; Great Australian Bight, 999-1 110 m depth.

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